VIKHTER, Yakov Isaakovich; MAK, Isaak L'vovich; SHVAGIREV, Mikhail Petrovich; PECHURO, S.S., nauchnyy redaktor; TYUTYUNIK, M.S., redaktor; PANOVA, L.Ya., tekhnicheskiy redaktor.

[Production of gypsum and gypsum construction elements] Proizvodstvo gipsa i gipsovykh stroitel'nykh detalei. Moskva, Gos. izd-vo lit-ry po stroit. materialam, 1954. 140 p. (MLRA 8:2)
(Gypsum) (Building materials)

ACC NR: AP7006122

large number of competing transverse modes in the laser, with diffraction losses playing the major role in this competition. Using quantitative data from an earlier study (ZhTF v. 37, 139, 1967), it is shown that by judicious selection of the modes it is possible to reduce the beam divergence to a value close to the diffraction limit, without greatly reducing the generation power. Orig. art. has: 5 figures, 3 formulas, and 2 tables. [02]

SUB CODE: 20/ SUBM DATE: 25May66/ ORIG REF: 013/ OTH REF: 006 /
ATD PRESS: 5117

Card 2/2

ACC NR: AP7006122 SOURCE CODE: UR/0056/67/052/001/0012/0020

AUTHOR: Anan'yev, Yu. A.; Mak, A. A.; Sedov, E. M.

ORG: none

TITLE: Angular divergence of emission from a solid state laser

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 52, no. 1, 1967, 12-20

TOPIC TAGS: LASER EMISSION, solid state laser, paramagnetic laser, laser beam, ~~beam divergence~~, neodymium glass, ~~glass laser~~, calcium fluoride, NEODYMIUM LASER, LASER CAVITY

ABSTRACT: To determine the influence of pump and cavity parameters on the divergence of a solid state laser, and to ascertain the degree to which laser mode selection is affected by the connection between the angle and energy characteristics of the laser, the authors measured the beam divergence of neodymium-glass and $CaF_2:Sm^{++}$ lasers whose pump and cavity parameters were varied. The beam divergence was determined by a photographic procedure. The pump was a straight xenon flash lamp in an elliptic reflector. The cavity length ranged from 0.5 to 300 cm. The pump energy did not exceed 50 - 70 J for the $CaF_2:Sm^{2+}$ laser and 130 J for the neodymium-glass laser. The beam divergence was found to be practically independent of the excess energy over threshold and of the reflection coefficient of the cavity mirror. The generated power, the beam divergence, and the threshold of pump intensity all decreased with increasing cavity length, but by varying degrees, the divergence being inversely proportional to the square root of the cavity length in an appreciable range of lengths. It is concluded that the experimentally observed beam divergence is governed by the excitation of a

Card 1/2 UDC: none

ACC NR: AP7004139

weak temperature dependence. The broadening is assumed to be inhomogeneous. Radiochemical reduction results in a lower $Dy^{++}$ ion concentration (up to 5% of the total Dy in the crystal) than reduction in calcium vapor (up to 15%). The concentration quenching of the luminescence is negligible. An empirical scheme is presented for the lower levels of $Dy^{++}$ in the $CaF_2$. Orig. art. has: 8 figures. [02]

SUB CODE: 20/ SUBM DATE: 29May65/ ORIG REF: 002/ OTH REF: 003
ATD PRESS: 5115

Card 2/2

ACC NR: AP7004139 SOURCE CODE: UR/0051/67/022/001/0068/0073

AUTHOR: Galaktionova, N. M.; Yegorova, V. F.; Zubkova, V. S.; Mak, A. A.

ORG: none

TITLE: Spectroscopic investigation of $CaF_2:Dy^{++}$ crystals

SOURCE: Optika i spektroskopiya, v. 22, no. 1, 1967, 68-73

TOPIC TAGS: calcium fluoride, activated crystal, luminescence spectrum, absorption spectrum, line width, line broadening, chemical reduction, DYSPROSIUM, IONIC CRYSTAL

ABSTRACT: The authors used high-resolution apparatus, consisting of a diffraction-grating monochromator and of a Fabry-Perot inteferometer combined with a monochromator, to investigate the luminescence and absorption spectra of $CaF_2:Dy^{++}$ crystals. Two types of crystals were tested, reduced by exposure to gamma ray and by treatment with calcium vapor. The former showed much higher absorption at 300-400 nm wavelength than the latter, which is attributed not to the formation of $Dy^{++}$, but to the production of other centers in the crystal. The latter showed more absorption near 700 nm. The two types of crystals differed also in their thermal and radiation stability and in their degree of discoloring. The luminescence spectra consisted of two line groups near 2.3 and 2.6 μ. Lowering the temperature decreased the number of lines in the groups. The line contours were also temperature dependent, changing from Maxwellian to Lorentzian with rising temperature. The luminescence line widths were found to be quite small, reaching 0.04-0.08 $cm^{-1}$ at 4.2K, with

Card 1/2 UDC: 535.3 2:535.34:542.0

ACC NR: AP6036692

seconds later due to the insufficient cooling of the active medium. In the case of the $CaF_2:Sm^{2+}$ laser, the active material was placed in a Pyrex-glass cell and cooled by helium gas (5—6K, flowing at 140 g/cm$^2$·sec). The undesirable u-v was filtered by an aqueous solution of sodium nitrite. Although the experiments were carried out during bright, cloudless days, no generation was achieved in $CaF_2:Sm^{2+}$ even at D = 150 cm, perhaps because of the overheating of the crystal or insufficient pumping. In the case of the $CaWO_4:Nd^{3+}$ laser, the active material was placed in a water-cooled glass tube (flowing at 1—2 liters/min). The u-v radiation was eliminated by an aqueous solution of sodium nitrite flowing at 10 liter/min. Cw generation was observed during cloudless days from 11:00 A. M. to 2:00 P. M. The smallest D for which cw generation at 1.06 μ occurred was 50—100 cm, depending on the quality of the crystal. The maximum generation power, 130 mw, was obtained at D = 150 cm. Stable operation was observed at D = 110 cm. Cw generation was interrupted when the mirror (D = 150 cm) was exposed to radiation for 30—40 sec. Orig. art. has: 5 figures.

SUB CODE: 20/ SUBM DATE: 31Mar66/ ORIG REF: 007/ OTH REF: 007/
ATD PRESS: 5108

Card 3/3

ACC NR: AP6036692

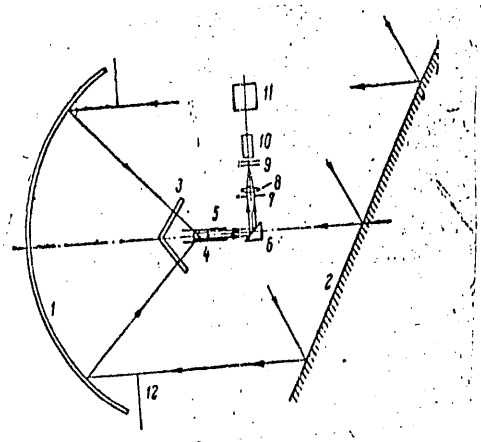


Fig. 1. Laser with solar radiation pumping

1 - Parabolic mirror; 2 - plane mirror; 3 - conical cell; 4 - active medium; 5 - heat exchanger; 6 - prism; 7 - diaphragm; 8 - lens; 9 - light filters; 10 - thermal sensor; 11 - photomultiplier; 12 - variable diaphragm.

sides) aluminum mirror 2 was used to direct solar rays onto the parabolic mirror in those cases when low-temperature (30—77K) crystals were used with complicated cooling systems, so that the active material remained undisturbed in the region of maximum illumination of the parabolic mirror as it followed the sun. Other components of the radiation-concentration system are described in detail. In the case of the $CaF_2:Dy^{2+}$ laser, the active material was cooled by liquid $O_2$ precooled by N to 77K, and cw generation was achieved at D = 50 cm, although it was interrupted several

Card 2/3

ACC NR: AP6036692 SOURCE CODE: UR/0237/66/000/011/0025/0029

AUTHOR: Kozlov, N. A.; Mak, A. A. (Candidate of sciences); Sedov, B. M.

ORG: none

TITLE: Solid-state laser pumped by solar radiation

SOURCE: Optiko-mekhanicheskaya promyshlennost', no. 11, 1966, 25-29

TOPIC TAGS: solid state laser, paramagnetic laser, samarium doped laser, dysprosium doped laser, neodymium glass laser, solar radiation, laser pumping, solar radiation pumping

ABSTRACT: An experimental study was made of cw $CaF_2:Dy^{2+}$, $CaF_2:Sm^{2+}$, and $CaWO_4:Nd^{3+}$ lasers pumped by solar radiation. The $CaF_2:Dy^{2+}$ and $Sm^{2+}$ crystals were 8 mm long and 3 mm in diameter and the $CaWO_4:Nd^{3+}$ crystals, 11 and 3 mm, respectively, their ends being coated with a highly reflective dielectric. The optical system for the concentration of the solar radiation is shown in Fig. 1. The parabolic mirror is made of aluminum-reinforced cast glass. The mirror aperture D (regulated by variable diaphragms 12) was 55 to 150 cm and its focal length 62.5 cm. The mirror was independently suspended and could rotate in two planes (0 to 360° horizontally, and -10 to + 90° vertically). A conical cell 3, cooled by an aqueous solution of sodium nitrite (or bichromate), was used to cut off the u-v radiation; its transmission (with filters 9) in the 0.5—1.0 μ region was 85—90%. A plane octahedral (140 cm between

Card 1/3 UDC: 621.375.9

L 45781-66

ACC NR: AP6027899

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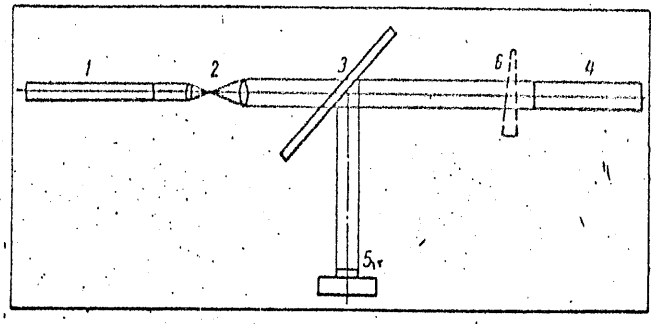



Fig. 1. Optical diagram of the set-up

1 - gaseous laser; 2 - telescope for increasing beam diameter; 3, 6 - transparent plates; 4 - test specimen; 5 - camera.

a study was made of the deformation of the end faces of the specimens, as well as of the birefringence in them due to thermal stresses. The results obtained show that the deformation of a laser resonator during optical pumping of an activated specimen is due to the nonuniformity of the temperature distribution in the specimen as well as to the thermal stresses resulting from this nonuniformity. Furthermore, at high temperature drops the effect due to these stresses is substantial. In conclusion, the authors express their gratitude to V. S. Doladugina and Ye. G. Berezina for useful discussions. Orig. art. has: 3 formulas, 1 table, and 3 figures. [26]

SUB CODE: 20/ SUBM DATE: 05Jul65/ ORIG REF: 008/ OTH REF: 002 / ATD PRESS: 5085

Card 2/2

L 45781-66 EEC(k)-2/EWP(k)/EWT(l)/EWT(m)/T/EWP(e) IJP(c) WG/WH

ACC NR: AP6027899 SOURCE CODE: UR/0368/66/005/001/0051/0055

71
69
B

AUTHOR: Anan'yev, Yu. A.; Kozlov, N. A.; Mak, A. A.; Stepanov, A. I.

ORG: none

TITLE: Thermal deformation of the resonator of a solid-state laser 25

SOURCE: Zhurnal prikladnoy spektroskopii, v. 5, no. 1, 1966, 51-55

TOPIC TAGS: solid state laser, laser resonator, thermal deformation, thermal stress, temperature distribution

ABSTRACT: The authors investigate the thermal deformation of a laser resonator due to nonuniform heating by the active material. The experiment was carried out with cylindrical specimens of neodymium glass (80 mm long, 5 mm in diameter) with frosted lateral faces pumped by a xenon flashlamp. The experimental set-up used is described and illustrated (Fig. 1). Considerable deformation of the resonator was observed in all the modes tested. A comparison of the experimental data with the calculations performed revealed that with increasing temperature drop in the specimen, the deviation of the experimental and the calculated quantities of the optic behavior increases, reaching a peak at T = 38C. In order to determine the reasons for this divergence,

Card 1/2 UDC: 621.378.325

L 41695-66

ACC NR: AP6008040

eous quantum of a given frequency, taking losses into account. The effective length of the rods is calculated and the average photon paths incident to the walls are described in relation to rod diameter. A more effective method is given for finding the number of spontaneously induced quanta, based on the spectral density of the illumination. Conditions are outlined for the generation mode and equations are given for finding maximum pulse power, generation energy, and pulse duration. Calculations are made for both three- and four-level systems and results for maximum power are plotted. Presented by Academician A. A. Lebedev on 31 May 1965. Orig. art. has: 11 formulas, 2 figures.

SUB CODE: 20/ SUBM DATE: 27May65/ ORIG REF: 006/ OTH REF: 003

Card 2/2 af

L 17605-66 EWP(m)/EWT(l)/EWP(v)-2/T/EWP(k) IJP(c) WW

ACC NR: AP6008040 SOURCE CODE: UR/0020/66/166/004/0825/0828

AUTHOR: Anan'yev, Yu. A.; Balashov, I. F.; Mak, A. A.

ORG: none

TITLE: Theory of monopulse operation of lasers

SOURCE: AN SSSR. Doklady, v. 166, no. 4, 1966, 825-828

TOPIC TAGS: laser pulsation, laser radiation, laser emission, laser energy

ABSTRACT: The theoretical examination of the monopulse mode of laser operation made in this paper includes the processes following the instantaneous increase in resonator $Q$ as well as the process of energy accumulation in the active medium. When the inverted population is large, spontaneous emission is amplified and the lifetime of the excited state is decreased. This, together with the light leakage from the active medium, is one of the main factors limiting energy accumulation and consequently the generated power as well. The media considered are three- and four-level solid state rods with polished and mat side surfaces. Energy accumulation in the active medium must continue for a time exceeding the effective lifetime of the excited state in order to obtain the maximum population inversion. The population inversion is found for a three- and a four-level medium, taking into account spontaneous and induced radiation. Equations are derived for calculating the number of quanta induced by spontan-

UDC: 621.378.3

Card 1/2

L 44076-66

ACC NR: AP6030713

with results obtained elsewhere (Yu. A. Anan'yev and Ye. A. Korolev, O & S, 16, 702, 1964). All data were found to be in agreement. The efficiency of circular-cylinder reflectors with optimal parameters may be as high as 75%. Orig. art. has: 1 table and 4 figures. [YK]

SUB CODE: 20/ SUBM DATE 09Nov65/ ORIG REF: 005/ OTH REF: 011/ ATD PRESS: 5075

Card 3/3

mental results, shown in Table 1, indicate that there exists an optimal reflector diameter for which the efficiency is a maximum. The pump light distribution in two

Table 1. Efficiency of laser reflectors

| Type of Reflector | Major axis (mm) | Diameter (mm) | Distance between lamp and rod axes (mm) | Dimensions of flashlamp and rod: dia. (mm) | Dimensions of flashlamp and rod: length (mm) | Efficiency: experimental | Efficiency: calculated |
|---|---|---|---|---|---|---|---|
| Standard | — | — | 9 | 5 | 45 | — | 0,25 |
| Elliptic cylinder | 100 | — | 40 | 5 | 45 | 0,36 | 0,38 |
| | 100 | — | 40 | 8 | 80 | — | 0,29 |
| Circular cylinder | — | 19 | 9 | 8 | 80 | — | 0,61 |
| | — | 20 | 9 | 8 | 80 | 0,58 | 0,63 |
| | — | 30 | 9 | 8 | 80 | 0,25 | 0,36 |
| | | 44 | 9 | 8 | 80 | 0,07 | 0,17 |
| | | 40 | 9 | 8 | 80 | | 0,6 |
| | | 50 | 9 | 8 | 80 | 0,05 | |
| | | 52 | 9 | 8 | 80 | 0,04 | 0,16 |

laser rods (one 8 mm in diameter in an elliptic cylinder reflector and 8 mm in a 30-mm-diameter circular-cylinder reflector) [illegible]

Card 2/3

L 44076-66 EWT(l)/EEC(k)-2/T/EWP(k) IJP(c) WG

ACC NR: AP6030713 SOURCE CODE: UR/0368/66/005/002/0167/0171

AUTHOR: Antoshina, Ye. N.; Kozlov, N. A.; Mak, A. A.; Stepanov, A. I.; Prilezhayev, D. S.

ORG: none

B

47

TITLE: Efficiency of reflectors for solid-state lasers 15

SOURCE: Zhurnal prikladncy spektroskopii, v. 5, no. 2, 1966, 167-171

TOPIC TAGS: solid state laser, laser reflector, pumping source, xenon lamp

ABSTRACT: Methods of determining the efficiency of solid-state laser reflectors were considered. The efficiency of elliptic- and circular-cylinder reflectors and the distribution of pumping energy in cylindrical neodymium-glass rods were determined experimentally. Elliptic-cylinder reflectors were prepared from metal with a surface coefficient of reflection R = 0.8—0.9. The flashlamp and the glass rod were placed along the major axis. Circular-cylinder reflectors were made of glass tubes whose outer surface was silver-coated (R ~ 0.9). The reflector end-caps were made of metal (R ≈ 0.8—0.9). The flashlamp and specimen were parallel to the cylinder axis and were equidistant from the center. The standard reflector used in the comparative experiments consisted of four spherical mirrors with R ≈ 0.8. The efficiency of the elliptic- and circular-cylinder reflectors was determined from the comparison of the generation energy of power therein with that of the standard reflector. The experi-

Card 1/3 UDC: 621.378.325

L 29216-66
ACC NR: AP6015433

taneous emission in the 2.512, 2.518 and 2.518 μ bands. The interaction between centers of the first and second type in these crystals is discussed. Orig. art. has: 7 figures. [14]

SUB CODE: 20/ SUBM DATE: 22Jun64/ ORIG REF: 005/ OTH REF: 003/
ATD PRESS: 5104

Card 3/3 LC

types of centers (mixed type) show more complex spectra. The difference between crystals of the first and second type is most pronounced in the absorption and luminescence spectra in the near infrared region. The spectrum for crystals of the first type is rather simple in the 2.1–2.6 μ region. Absorption resonance lines are observed at 2.15 and 2.223 μ and an additional line is observed in the luminescence spectrum at 2.43 μ which disappears at helium temperatures as well as a line at 2.512 μ which is observed at low temperatures. Luminescence excitation in crystals of the first type is due chiefly to absorption in the 0.4–0.6 μ region of the spectrum. The spectrum for crystals of the second type is more complex with six resonance lines at 2.15, 2.252, 2.246, 2.237, 2.228, and 2.221 μ which may be due to transitions between the ground level and splitting components of the $^4I_{11/2}$ state. Luminescence excitation for crystals of the second type takes place chiefly in the 0.7–1.2 μ spectral region due to wide absorption bands. Experimental data were used for constructing the diagrams of lower levels for crystals of both types. Considerable interaction is observed between centers of the first and second type in mixed crystals. Crystals of the first type show stimulated emission in three spectral bands: 2.512 μ, 2.435 μ, and 2.223 μ. The positions of the emission peak with respect to time for the 2.512 and 2.223 μ bands show a considerable degree of correlation: the emission maximum in one band corresponds to the minimum in the other. This indicates that these bands have a common initial upper level. Stimulated emission is observed in crystals of the second type in the 2.518 and 2.61 μ bands. Stimulated emission in crystals of this type is due basically to absorption bands at 0.8 and 0.9 μ. Mixed crystals show simul-

L 29216-66

ACC NR: AP6015433 SOURCE CODE: UR/0051/66/020/005/0890/0897

AUTHOR: Yegorova, V. F.; Zubkova, V. S.; Mak, A. A.; Prilezhayev, D. S.

ORG: none

TITLE: Luminescence and stimulated emission spectrum of $CaF_2$-$U^{3+}$ crystals

SOURCE: Optika i spektroskopiya, v. 20, no. 5, 1966, 890-897

TOPIC TAGS: absorption spectrum, excitation spectrum, luminescence spectrum, crystal phosphor, fluorite, color center, uranium

ABSTRACT: Data are given from a detailed analysis of the absorption, luminescence, and stimulated emission spectra of fluorite crystals activated by trivalent uranium ions at 4.2-300°K. A vacuum monochromator with a resolution of 1.5-3 Å at $\lambda$=2.5 $\mu$ was used for taking the absorption and luminescence spectra. An incandescent lamp with a tungsten filament was used for exciting luminescence in the crystal. An FEU-22 photomultiplier and a cooled lead sulfide resistor were used as detectors. The recording system was made up of an amplifier, a synchronous detector, and a PS1-02 electronic potentiometer. It was found that the absorption spectra of these crystals is due to at least four types of color centers. The specimens were divided into two classes, the first being lilac in color and the second—red. Each type has its distinct characteristics in absorption, luminescence, and excitation spectra. Crystals containing both

Card 1/3 UDC: 621.375.9 : 535

L 2082-66
ACC NR: AP5026595

the stimulated emission spectrum of crystals, which leads to mode tightening, can be considerable. When no thermal effects are assumed, mode tightening is independent of pumping. A fully quantitative interpretation of the data would require consideration of effects associated with the field distribution in a resonator and other effects (H. Haken, H. Sauermann, Zs. Phys., 173, 261, 1963; 176, 47, 1963). [YK]
Orig. art. has: 1 table and 3 figures.

SUB CODE: SS, OP/ SUBM DATE: 21May65/ ORIG REF: 006/ OTH REF: 003/ ATD PRESS: 4122

Card 4/4

L 2082-66
ACC NR: AP5026595

Table 1. Averaged experimental data

| Crystal | L, mm | Mirror transmissivity, % | Operation | T, °K | No. of modes | Δλ, Å | Mode intensity ratio | Δλ/Δλp |
|---|---|---|---|---|---|---|---|---|
| $CaF_2:Dy^{2+}$ | 29 | 20 | Continuous, threshold | ~80 | 1 | | | |
| | | | Continuous, super-threshold-3 | ~80 | 2 | 0.47 | 1:0.07 | 0.7 |
| $CaF_2:Dy^{2+}$ | 40.5 | 20 | Continuous, threshold | ~80 | 2 | 0.46 | 0.65:1 | 0.95 |
| | | | Continuous, super-threshold-3 | ~80 | 3 | 0.4; 0.3 | 0.5:0.5:1 | 0.83; 0.62 |
| | | | Pulsed | 98 | 3 | 0.43 0.48 | 1:0.9:0.5 | 0.89; 1.0 |
| $CaF_2:Dy^{2+}$ | 40.5 | 2 | Pulsed | <72 | 1 | | | |
| | | | | 74 | 2 | 0.4 | | 0.83 |
| | | | | 86 | 2 | 0.45 | | 0.93 |
| | | | | 100 | 2 | 0.48 | | 1.0 |
| $CaF_2:Dy^{2+}$ | 36.5 Confocal resonator | 5 | Pulsed | 94 | 2 | 0.2 | 0.7:1 | 0.74 |
| $CaF_2:U^{3+}$ | 23 | 53 | Pulsed | 28 | 1 | | | |
| | | | | 46 | 2 | 0.3 | 1:0.7 | 0.39 |
| | | | | 68 | ≥3 | 0.54 equidist modes | | 0.71 |
| | | | | 86 | >4 | 0.76 equidist modes | | |

Card 3/4

The number of displacements for $CaF_2:Dy^{2+}$ was from 1 to 3, depending on the crystal temperature, excess threshold energy, and mirror transmissivity. The decrease in

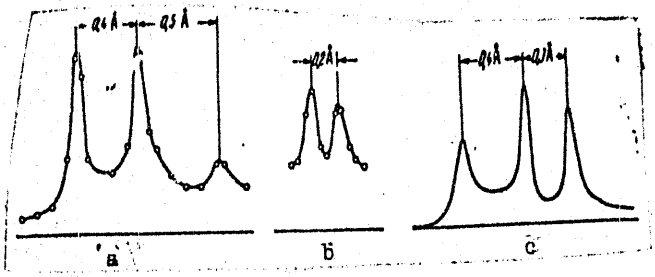



Fig. 1. Stimulated emission spectra

a - Pulsed mode, L = 40.5 mm, T = 97K; b - pulsed mode, confocal resonator, L = 36.5 mm, T = 94K; c - continuous mode, L = 40.5 mm, T = 80K.

temperature and the corresponding narrowing of the luminescence line caused a decrease in $\Delta\lambda$ (difference in wavelength of two adjacent axial modes) and, in the case of $CaF_2:Dy^{2+}$, disturbed the mode equidistance. The averaged experimental data are presented in Table 1. The data indicate that the effect of anomalous dispersion of

L 2082-66 EWA(k)/FBD/EWT(l)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c) WG

ACC NR: AP5026595 SOURCE CODE: UR/0056/65/049/004/1068/1071

AUTHOR: Galaktionova, N. M.; Yegorova, V. F.; Mak, A. A.

ORG: State Optical Institute (Gosudarstvennyy opticheskiy institut)

TITLE: The effect of anomalous dispersion on the stimulated emission spectrum of crystals

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 4, 1965, 1068-1071

TOPIC TAGS: solid state laser, stimulated emission, dispersion, anomalous dispersion, spectroscopy, dysprosium ion, uranium ion

ABSTRACT: A study was made of the stimulated emission spectra of $CaF_2:Dy^{2+}$ crystals at $\lambda = 2.36\ \mu$, and $CaF_2:U^{3+}$ crystals at $\lambda = 2.22\ \mu$ (see Fig. 1). The crystal temperature was varied in the 30—100K range. The dependence of the luminescence linewidth on temperature was established for both crystals. Spectroscopic investigations carried out by means of photoelectric equipment with a Fabry-Perot etalon (base L = 10—30 mm) showed that in the above temperature range the $CaF_2:U^{3+}$ crystals exhibited a Lorentz line shape, and the $CaF_2:Dy^{2+}$ a Gaussian shape, which is indicative of a nonuniform line broadening in the $CaF_2:Dy^{2+}$ crystals. Multilayer dielectric mirrors with a 98% reflection coefficient (at $\lambda = 2.36\ \mu$) were used. Spectrum scanning was carried out with the etalon inside a variable-pressure baric chamber. The displacement of modes (up to 0.1 Å) due to temperature instability was considerable.

Card 1/4

L 25312-65

ACCESSION NR: AP5004366

The results show that gain decreased when signal intensity increased. This relationship was most noticeable at high gain. The theoretical and experimental results were in good agreement, except when the coefficient of amplification was equal to or exceeded 7. In this case, the disagreement was apparently due to a decrease in the lifetime of the excited state (in the presence of considerable population inversion) which leads in turn to a decrease in the gain. Orig. art. has: 6 formulas and 3 figures. [YK]

ASSOCIATION: Gosudarstvennyy opticheskiy institut im. S. I. Vavilova (State Optical Institute)

SUBMITTED: 10Apr64 ENCL: 00 SUB CODE: EC, OP

NO REF SOV: 003 OTHER: 002 ATD PRESS: 3184

Card 2/2

L 25912-65 EWA(k)/EWT(l)/EEC(k)-2/T/EEC(b)-2/EWP(k)/EWA(m)-2 Po-4/Pf-4/Pi-4/
Pl-4 IJP(c) WG/JHB

ACCESSION NR: AP5004366 S/0056/65/048/001/0007/0012

51
50
B

AUTHOR: Anan'yev, Yu. A.; Mak, A. A.; Sedov, B. M.

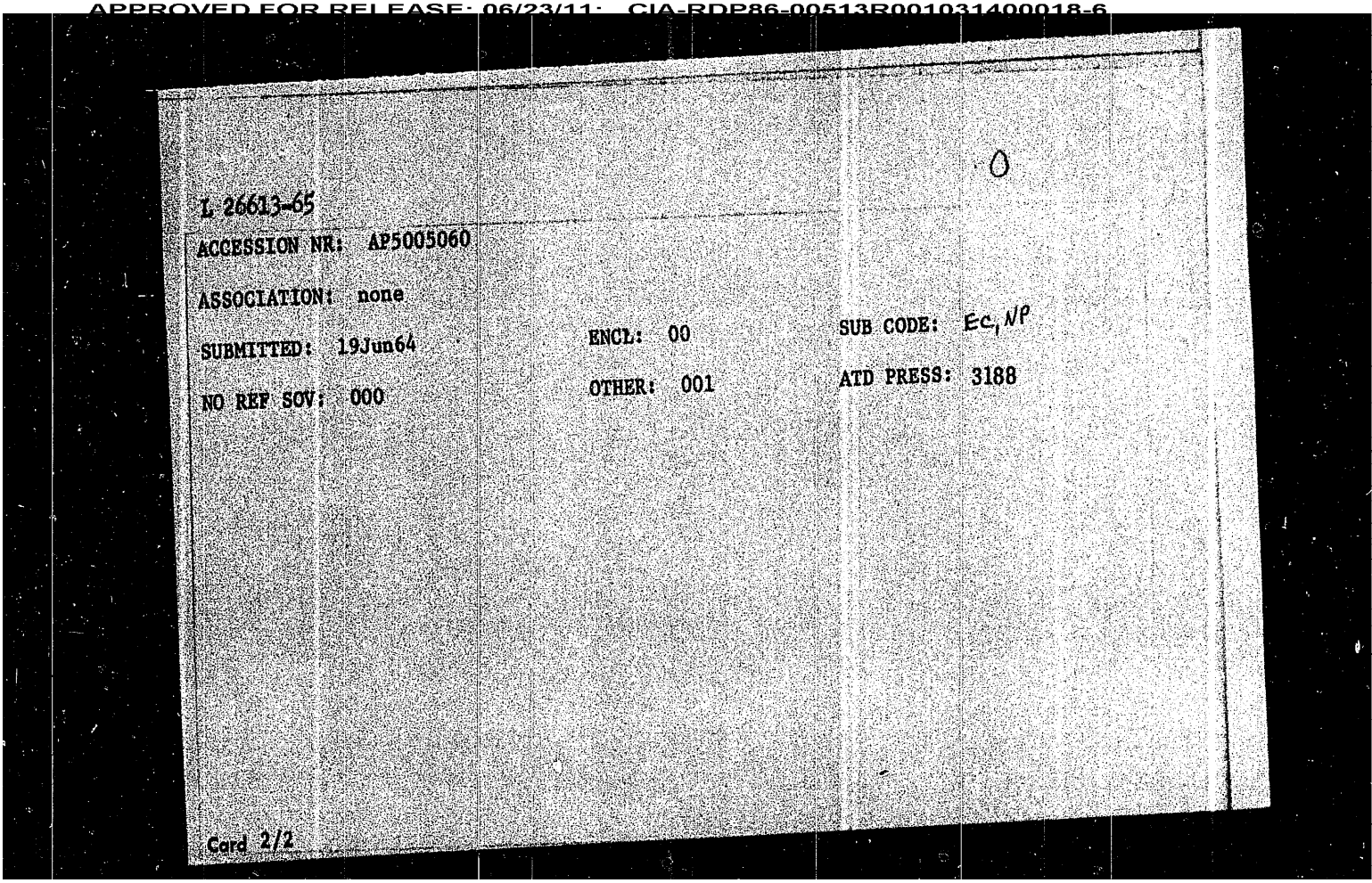
TITLE: Amplification of light by four-level quantum systems

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 48, no. 1, 1965, 7-12

TOPIC TAGS: four level system, light amplification, $CaF_2:Sm^{2+}$ laser, paramagnetic laser, laser amplifier

ABSTRACT: A study was made of the amplification of light in a four-level laser system in which the signal wavelength corresponded to the maximum coefficient of negative absorption of the medium. The theoretical studies, based on a probability method, were made for the steady and transient states of amplification. The experimental investigation was limited to the measurement of the gain in a steady state. For this purpose, the authors used $CaF_2:Sm^{2+}$ crystals at 20K. Two cylindrical rods 30 mm long and 8 mm in diameter with coated plane ends and unpolished sides were placed in a cryostat. One of the rods, pumped by a pulse 25—30 μsec in duration, acted as a signal source; the other, pumped by a longer (150 μsec) pulse, was the amplification. Gain measurements were carried out at various pumping intensities.

Card 1/2



L 26613-65

ACCESSION NR: AP5005060

ASSOCIATION: none

SUBMITTED: 19Jun64 ENCL: 00 SUB CODE: Ec, NP

NO REF SOV: 000 OTHER: 001 ATD PRESS: 3188

Card 2/2

APPROVED FOR RELEASE: 06/23/11: CIA-RDP86-00513R001031400018-6

L 26613-65 EWG(j)/EWA(k)/FBD/EWT(l)/EEC(k)-2/EEC(t)/T/EEC(b)-2/EWP(k)/EWA(h)/EWA(m)-2
Pn-4/Po-4/Pf-4/Peb/Pi-4/P1-4 IJP(c) WG

ACCESSION NR: AP5005060 S/0051/65/018/002/0353/0354

AUTHOR: Yermakov, B. A.; Lukin, A. V.; Mak, A. A.

TITLE: Reducing metastable level lifetime in a modulated-Q laser

SOURCE: Optika i spektroskopiya, v. 18, no. 2, 1965, 353-354

TOPIC TAGS: laser, metastable level lifetime, metastable level population, Q modulator, Q spoiler

ABSTRACT: Stored excitation energy is limited by the decrease in effective metastable level lifetime when Q modulation tends to enhance spontaneous emission. The problem was examined in a four-level system in which the population $N_M$ of the metastable level was considerably smaller than the population of the ground state. The dependence of the effective excited state lifetime ($\tau_{eff}$) on the number of stimulated transitions and on the population $N_M$ of the metastable level was determined. In the first approximation $\tau_{eff}$ can be regarded as equal to the time constant of the emission decay after the end of the pumping pulse; it was found to be 2.8 msec, considerably smaller than the lifetime $\tau$ = 20 msec determined from scintillation decay. The results obtained show that the lifetime of the metastable level can decrease considerably when the operation is conducted at a single pulse regime. Orig. art. has: 1 figure and 2 formulas. [JA]

Card 1/2

L 7691-66

ACC NR: AP5028019

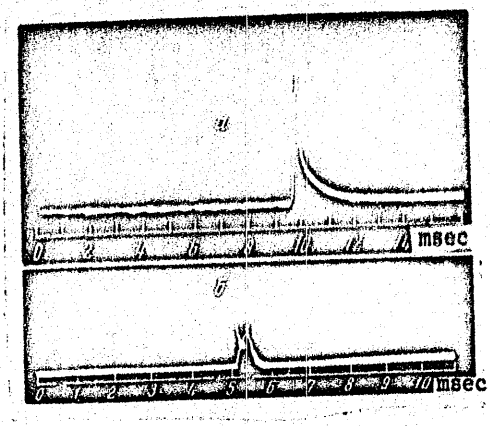



Fig. 2. Monopulse oscillograms

speeds, several laser pulses were obtained rather than one (Fig. 2b). Orig. art. has: 2 figures. [02]

SUB CODE: EC/ SUBM DATE: 31Aug65/ ORIG REF: 002/ ATD PRESS: 4141

Card 3/3

L 7691-66
ACC NR: AP5028019

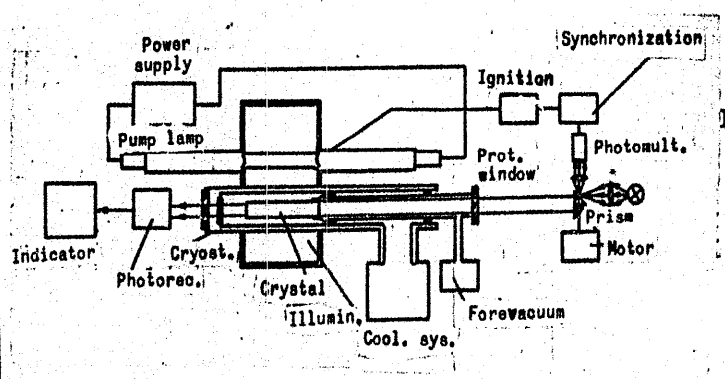



Fig. 1. Experimental setup

~4 x $10^3$ W. In several crystals monopulse 4-level generation ($\lambda_4$ = 2.51 μ) was obtained, apparently, because of the high concentration of the activator in these crystals. The shape of the pulse was the same as in Fig. 2a. The maximum laser energy in the monopulse was $10^{-3}$ J in this case (pulse power ~5 x $10^4$ W). At smaller prism

Card 2/3

L 7691-66 EWA(k)/FBD/EWT(1)/EWT(m)/EPF(c)/EEC(k)-2/T/EWP(t)/EWP(k)/EWP(b)/ EWA(m)-2/EWA(h) SCTB/LJP(c) WG/JD/JW

ACC NR: AP5028019 SOURCE CODE: UR/0386/65/002/008/0380/0383

AUTHOR: Yermakov, B. A.; Lukin, A. V.; Mak, A. A.; Prilezhayev, D. S.

ORG: none

TITLE: Monopulse generation with $CaF_2:U^{3+}$ crystals

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu (Prilozheniye), v. 2, no. 8, 1965, 380-383

TOPIC TAGS: solid state laser, laser pulsations, laser

ABSTRACT: This is a continuation of earlier work (Optika i spektroskopiya v. 18, 353, 1965) in which attainment of monopulse generation in the 2.36μ infrared region with $CaF_2:Dy^{2+}$ was reported. In the present paper the authors report attainment of monopulse generation with $CaF_2:U^{3+}$ crystals at wavelengths 2.22 and 2.51 μ, using an experimental setup in which the crystals are cooled to 80—90K by a jet of nitrogen gas evaporated from the liquid phase (Fig. 1). A semitransparent coating with reflection coefficient R = 0.95 ± 0.6 was deposited on one end of the crystal. The cavity switching was by means of a rotating total internal-reflection prism. The pump-lamp ignition was synchronized with a photoelectric system coupled to the prism rotating at 1—2 x $10^4$ rpm. The crystals used were 3—55 mm in diameter and 20—30 mm long. The radiation receiver was a Ge:Au photoresistance, and the generated energy was measured with a bolometer. The monopulse lasing at $\lambda_3$ = 2.22 μ was of the three-level type (Fig. 2a), with emission energy 0.1 x $10^{-3}$ J, corresponding to a pulse power of

Card 1/3

ACCESSION NR: AP4039712

in an elliptical reflector. In order to investigate deformation due to pumping, two identical crystals were placed separately in each arm of the Mach-Tsender interferometer and only one crystal was excited. Comparative photographs of interferograms show that the thermal deformation of crystal is a function of the initial temperature of the crystal. This is due to an increase in the coefficient of thermal expansion of fluorite with increases in temperature. The difference in the optical path at the axis and at the edge of the rod is 1.5 bands at an initial temperature of 300K and pumping-energy density of 300 $j/cm^3$ of the crystal. At an initial temperature of 50K, the average temperature increase due to pumping was 12K. The nature of crystal deformation is independent of generation in a crystal. The density of absorbed excitation energy is 35% higher along the crystal axis than the average density in the crystal. Additional deformation occurs in the form of crystal lengthening. This leads to a change in the wavelength of stimulated emission. Orig. art. has: 1 formula and 3 figures.

ASSOCIATION: none

Card 2/2

ACCESSION NR: AP4039712 S/0051/64/016/006/1065/1068

AUTHOR: Anan'yev, Yu. A.; Mak, A. A.

TITLE: Variation of resonator characteristics in an optical laser during the generation process

SOURCE: Optika i spektroskopiya, v. 16, no. 6, 1964, 1065-1068

TOPIC TAGS: optical laser, solid state laser, fluorite laser, samarium doped laser, laser resonator

ABSTRACT: The Stokes losses and nonuniform pumping of a solid-state laser can lead to the deformation of the crystal rod and the parallel-plate system. Experiments with a divalent samarium-doped fluorite laser were carried out to investigate the variation of resonator characteristics in the generation process. A crystal rod 8 mm in diameter and 33 mm long with flat ends was used. Dielectric coating about 0.708 μ thick was applied to make the ends reflective. The crystal was pumped by square-wave 700-μsec pulses by a flash lamp

Card 1/3

ACCESSION NR: AP4035484

16 when the crystal is heated to 60K. Theoretical and experimental results indicate that the heating, due to Stokes losses, of a crystal 33 mm long at 25K is less than 3—5 deg when the pumping energy is 22 joules and 15—20 deg at 92 joules. During the oscillation pulse the wavelength of each mode increases by 0.09Å, while the distance between adjacent modes remains constant at 0.088Å. For a 30-deg heating of the crystal, the total spectral shift of the laser was ~0.6Å, and thus the shift versus the heating rate was ~0.02Å/degree. The width of spectral modes varied during oscillation from 0.035Å (start) to 0.017Å (end). Results indicate that the various modes are independent of each other only at the start. Splitting of spectral modes into 2 components was observed at the start of oscillation; it amounted to ~0.035Å. The reason for this remains unknown. Orig. art. has: 1 formula and 5 figures.

ASSOCIATION: none

SUBMITTED: 16Aug63 DATE ACQ: 22May64 ENCL: 00

SUB CODE: PH NO REF SOV: 001 OTHER: 001

Card 2/2

ACCESSION NR: AP4035484 S/0051/64/016/005/0911/0914

AUTHOR: Anan'yev, Yu. A.; Galaktionova, N. M.; Mak, A. A.; Sedov, B. M.

TITLE: The emission spectrum of a samarium 2+ doped calcium fluoride laser

SOURCE: Optika i spektroskopiya, v. 16, no. 5, 1964, 911-914

TOPIC TAGS: emission spectrum, calcium fluoride laser, samarium 2+ doped laser, laser oscillation spectrum, laser crystal

ABSTRACT: The experimental investigation of the emission spectrum of a samarium 2+ doped fluoride laser (emitting at 0.708 μ) was performed to establish the relationship between the temperature of crystal and the broadening of the oscillation spectrum. This confirms that while at small pumping energies the number of modes is independent of the energy, it sharply increases at larger energies, reaching

Card 1/2

ACC. NR: AP4011499

in percent for different wavelength intervals for tubes of type (1). Spectral distribution and intensity versus voltage curves are given in figures. The experimental results indicate that under the discharge conditions employed the spectral luminous density does not depend on the dimensions of the tube and corresponds to the radiation from an absolute black body at 17000°-1800°K except in the ultraviolet, where the brightness temperature is somewhat lower, and in the regions of some Xe lines where the temperature is about 2000°K. Orig. art. has: 2 tables and 3 figures.

ASSOCIATION: none

| | | |
|---|---|---|
| SUBMITTED: 04Apr63 | DATE ACQ: 04Apr63 | ENCL: 00 |
| SUB CODE: PH | NR SOV REF: 004 | OTHER: 000 |

Card 2/2

ACCESSION NR: AP4011499 S/0051/64/016/001/0153/0155

AUTHOR: Galaktionova, N.M.; Mak, A.A.

TITLE: Spectral-time characteristics of the radiation of tubular xenon flash tubes

SOURCE: Optika i spektroskopiya, v. 16, no.1, 1964, 153-155

TOPIC TAGS: flash tube, xenon tube, laser, laser source, discharge tube, xenon spectrum, flash tube efficiency

ABSTRACT: In view of the importance of xenon filled flash tubes in laser research and operation, tubes of this type have been investigated to determine the emission spectrum and energy output as a function of the tube parameters and the discharge conditions. The test procedure, which entailed the use of a DMR-4 monochromator and a photoelectric recording attachment, has been described earlier (M.P. Vanyukov, A.A.Mak,and N. V.Parazinskaya, Opt.i spektr.,1956). The set-up was calibrated with reference to a ribbon filament lamp. Values of the peak spectral density and brightness temperature for different $\lambda$ for tubes 3 mm in diameter and 40 mm long (1) and 7.5 mm in diameter and 60 mm long (2) are tabulated (discharge conditions: V = 1000 v, C = 300 $\mu$f, L = 0); another table gives the energy yields

Card 1/2

L 15279-66
ACC NR: AT6001399

The brightness increase found in He + Xe mixtures did not materialize in tests using He + Ar mixtures. Orig. art. has: 2 figures.

SUB CODE: 20 / SUBM DATE: none / ORIG REF: 003

Card 3/3

L 15279-66
ACC NR: AT6001399

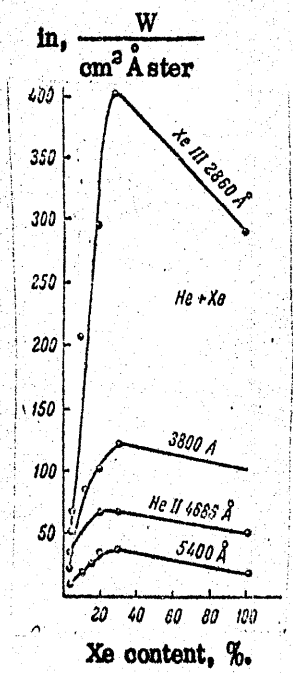



Fig. 1. Spectral brightness density as a function of Xe admixture in helium base gas

21

Card 2/3

L 15279-66 EWT(1)/EWT(m)/T/EWP(t)/EWP(b) IJP(c) JD
ACC NR: AT6001399 SOURCE CODE: UR/3180/64/009/000/0151/0152

AUTHOR: Vanyukov, M. P. (Candidate of physico-mathematical sciences); Galaktionova, N. A.; Yegorova, V. F.; Mak, A. A.

ORG: none

TITLE: Radiation from spark discharges in gas mixtures

SOURCE: AN SSSR. Komissiya po nauchnoy fotografii i kinematografii. Uspekhi nauchnoy fotografii, v. 9, 1964. Vysokoskorostnaya fotografiya i kinematografiya (High-speed photography and cinematography), 151-152

TOPIC TAGS: gas discharge plasma, gas discharge, xenon, helium

ABSTRACT: Earlier studies of the brightness of spark discharges showed that while in the case of light gases such discharges produce high temperature channels but achieve the limiting brightness only with strong discharges and at high pressures, heavy inert gases exhibit low limiting brightness, but this limit can be reached under soft discharge conditions and at low pressures. In the present note the authors investigate experimentally and theoretically a mixture of a light (basic) and heavy (admixture) gas which would allow the formation of very bright channels under soft discharge conditions and low pressures. Calculations of the ratio of energy losses due to the admixture to those of the basic gas and of the ratio of the respective coefficients of absorption showed that the most promising seem to be mixtures of gases of very different atomic weights (e.g., He + Xe). Experimental results are summarized in Fig. 1.

Card 1/3

L 13066-66

ACC NR: AT6001396

2

fairly random but strong increase in brightness was observed at the instant of maximum radiation in the region of the positive electrode in the case of the spark discharge taking place in helium and nitrogen. The authors express their deep appreciation to S. I. Levikov, who prepared the hydrogen and deuterium arc lamps, and to M. N. Smolkin, who calibrated them. Orig. art. has: 4 figures, 1 table.

SUB CODE: 20, 07 SUBM DATE: 00/ ORIG REF: 001/ OTH REF: 000

Card 2/2

L 10066-66 EWT(l)/EWA(m)-2

ACC NR: AT6001396 SOURCE CODE: UR/3180/64/009/000/0131/0137

AUTHOR: Vanyukov, M. P. (Candidate of physico-mathematical sciences); Galaktionova, N. M.; Mak, A. A.

84
82
B+1

ORG: none

TITLE: Radiation of pulsed light sources in the ultraviolet

SOURCE: AN SSSR. Komissiya po nauchnoy fotografii i kinematografii. Uspekhi nauchnoy fotografii, v. 9, 1964. Vysokoskorostnaya fotografiya i kinematografiya (high-speed photography and cinematography), 131-137

TOPIC TAGS: emission spectrum, gas discharge spectroscopy, xenon, neon, nitrogen, argon, helium, light pulse, optic brightness

ABSTRACT: The emission spectra of strong spark discharges in xenon, argon, neon, and air in the visible and ultraviolet range (2200-5500 Å) were studied. In the case of xenon and argon (gases of high atomic number), the spectra at the instant of maximum radiation consisted of continuous radiation with very diffuse and unresolved lines of singly and doubly ionized atoms of the gas; at later instants, a large number of lines of the ionized gas appear. In the lighter gases (air, neon), the line spectrum is pronounced even at the instant of maximum radiation. For nitrogen, argon, air, and xenon, the distribution of the spectral brightness density at the instant of maximum radiation corresponds to the brightness distribution of an absolute black body. A

Card 1/2

L 11056-66 EWT(1)/EWT(m)/EWP(t)/EWP(b) IJP(c) JD/WW/GG

ACC NR: AT6001393 SOURCE CODE: UR/3180/64/009/000/0115/0115

AUTHOR: Vanyukov, M. P. (Candidate of physico-mathematical sciences); Mak, A. A.

ORG: none

TITLE: Study of pulsed light sources of limiting brightness

SOURCE: AN SSSR. Komissiya po nauchnoy fotografii i kinematografii. Uspekhi nauchnoy fotografii, v. 9, 1964. Vysokoskorostnaya fotografiya i kinematografiya (High-speed photography and cinematography), 115

TOPIC TAGS: light source, gas discharge spectroscopy, helium, nitrogen, argon, optic brightness

ABSTRACT: In order to determine the limiting brightnesses of pulsed light sources, the brightness of the spark discharge channel was studied in an atmosphere of helium, argon, nitrogen, and air at high rates of current buildup in the discharge. To this end, a discharge circuit based on a low-induction cylindrical capacitor was developed. Measurements of the spectral density of the discharge channel brightness were based on the continuous and line emission in the 4000-9000 Å range. In all gases studied, the limiting brightness was successfully obtained. It was found that under limiting conditions the discharge channel is opaque and radiates like an absolute black body with a temperature equal to that of the channel. Orig. art. has: 1 table

SUB CODE: 20, 07/ SUBM DATE: 00/ ORIG REF: 002/ OTH REF: 000

Card 1/1 HW

L 10333-63
ACCESSION NR: AP3000740

low operating temperatures, the efficiency of the ideal four-level laser is very high. A formula is obtained relating power output to superthreshold pumping power. After the threshold is reached, large Nu sub 32 radiation densities are established within the cavity, changing the population of levels and thereby varying absorption power and other optical properties of the working substance. These changes can be calculated by means of the derived formulas. Orig. art. has: 1 figure and 24 formulas.

ASSOCIATION: Institut fiziki Akademii nauk BSSR (Institute of Physics, Academy of Sciences BSSR)

SUBMITTED: 29Dec62 DATE ACQ: 21Jun63 ENCL: 00

SUB CODE: 00 NO REF SOV: 004 OTHER: 000

mcs/ls
Card 2/2

L 10333-63 EWA(k)/EWT(1)/FBD/BDS/T-2/3W2/EEC(b)-2/ES(t)-2--AFFTC/ASD/ESD-3/RADC/APGC/AFWL--JHB/WG/K/EH/IJP(C)

ACCESSION NR: AP3000740 S/0020/63/150/003/0507/0510

AUTHOR: Anan'yev, Yu. A.; Gribkovskiy, V. P.; Mak, A. A.; Stepanov, B. I. (Academician AN BSSR)

TITLE: Properties of the four-level optical quantum generator 75 74

SOURCE: AN SSSR. Doklady*, v. 150, no. 3, 1963, 507-510

TOPIC TAGS: laser theory, four-level laser

ABSTRACT: A theoretical study of the behavior of a four-level laser with level 3 metastable has been conducted. It was assumed that there were no thermal transitions upward other than that from level 1 to level 2. Formulas showing the effect of working-substance parameters and cavity characteristics on the absorption and oscillation processes were derived. It is shown that in the absence of external losses a low threshold can be attained with high h Nu sub 21/kT values. With transition probabilities p sup 0 sub 32 close to p sup 0 sub 21 in value, the four-level system loses its advantages. Power output per unit resonator volume and the maximum power output of an ideal four-level laser are calculated. With low external losses and very

Card 1/2

L 10728-63

ACCESSION NR: AP3003116

of samarium-doped and uranium-doped calcium fluoride lasers on crystal temperature and reflection factor of the mirrors and to determine the relationship between pumping power and output power. Cylindrical crystals with dielectric-coated end faces were used with temperatures ranging from 8 to 300K. Experimental results were in good agreement with the theoretical. Conditions for the transition from four-level to three-level operation were found for the uranium-doped calcium fluoride laser. Orig. art. has: 10 formulas and 4 figures.

ASSOCIATION: Gosudarstvenny*y opticheskiy institut im. S. I. Vavilova (State Institute of Optics)

SUBMITTED: 21Feb63 DATE ACQ: 23Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 001 OTHER: 002

Card 2/2

L 10728-63 EWA(k)/EWT(1)/FBD/T-2/3W2/EEC(b)-2/ES(t)-2/BDS AFFTC/ASD/ESD-3/RADC/APGC/AFWL Pl-4/Po-4 JHB/WG/IJP(C)/K/EH

ACCESSION NR: AP3003116 S/0056/63/044/006/1884/1888 82 81

AUTHOR: Anan'yev, Yu. A.; Yegorova, V. F.; Mak, A. A.; Prilezhayev, D.S.; Sedov, B. M. 25

TITLE: On the operation of a four-level laser

SOURCE: Zhurnal eksper. i teor. fiziki, v. 44, no. 6, 1963, 1884-1888

TOPIC TAGS: four-level laser, trivalent uranium laser, divalent samarium laser, calcium fluoride laser

ABSTRACT: A theoretical and experimental study of the operation of a four-level laser has been conducted. Equations were derived for steady-state operation, cavity parameters, properties of working substances and host substances, pumping power, threshhold, energy-level populations, various transition probabilities, and output power. To verify the theoretical calculations, experiments were conducted to determine the dependence of pumping power and output power

Card 1/2

S/057/62/032/003/011/019
B111/B102

Distribution of temperature ...

tribution I(r) in the channel and the temperature dependence I(T). If the ionization equilibrium in the plasma is known, the temperature can be calculated by successive approximation (maximum error of the three methods ±10 - ±15%). The electron concentration was calculated by the Ornstein-Uhsink formula (Ref. 6: H. Brucker, T. Peters, Z. Phys., 130, 4-6, 1954; F. Finkelnburg, T. Peters, Handb. d. Phys., 22, Berlin, 1957) (maximum error ± 10%). Results: 1) The distribution of temperature and electron concentration in the spark channel is uniform. 2) The temperatures determined by the three methods agree well. Differences are below measurement accuracy. This justifies assuming a Boltzmann distribution of the excited atoms and using the Saha formula for ionization. 3) The wall temperature in the channel agrees well with the value on its axis. 4) The difference in the values of electron concentration obtained by measuring the background on the one hand and the shift of the spectral lines on the other is not due to inhomogeneities but to shortcomings in the plasma radiation theory. The authors thank L. P. Vanyukov for discussing the results. There are 6 figures, 1 table, and 11 references: 7 Soviet and 4 non-Soviet.

SUBMITTED: April 5, 1961 (initially) May 25, 1961 (after revision)

Card 2/2

1/30
S/057/62/032/003/011/019
B111/B102

26.7311

AUTHORS: Kolorova, V. F., Ivanenko, V. I., Lyak, A. A., and Shishova, A. I.

TITLE: Distribution of temperature and electron concentration in the channel of a spark discharge

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 3, 1962, 329 - 335

TEXT: Temperature distribution, plasma density, and widening rate of a spark channel were determined by measuring the intensity of its line spectrum (error 50%). With known temperature and intensity distribution of the radiation the electron concentration can be accurately determined by the given method. The measuring arrangement consisted of a monochromator, photomultiplier, and amplifier plus oscilloscope and of an electron-optical apparatus connected synchronously. The temperature in the spark channel was determined in Hg, air, and $N_2$ by three different methods: a) by measuring the absolute intensity of a spectral line, b) by measuring the intensity ratio of two spectral lines, c) by comparing the radial intensity dis-

Card 1/2

S/051/62/012/006/014/020
E039/E420

Limiting sensitivity ...

apparatus. The limiting sensitivity of the photo-electric method is estimated to be at least two orders of magnitude higher than for the photographic method. However, the photographic method has the advantage of permitting the simultaneous recording of quantitative information over a wide spectral (or time) interval. It is also shown that the use of an electron-optical converter will increase the sensitivity of the photographic method by approximately two orders of magnitude. The limitations of this method are discussed. There is 1 figure.

SUBMITTED: April 19, 1961

Card 2/2

S/051/62/012/006/014/020
E039/E420

AUTHORS: Anan'yev, Yu.A., Mak, A.A.

TITLE: Limiting sensitivity of methods for recording time-resolved emission spectra

PERIODICAL: Optika i spektroskopiya, v.12, no.6, 1962, 779-784

TEXT: A comparison is carried out between photo-electric and photographic (with and without electronic amplification) methods of recording from the point of view that accuracy of measurement will ultimately be limited by random fluctuations. It is implied that with photoelectric recording a monochromator will be used and for photographic recording a spectrograph, and that the intensity of radiation from the source should be uniform over a spectral range equal to the width of the apparatus function. It is shown that, in general, the following relation exists between the standard deviation in errors of measurement $\alpha$ in spectral $\Delta\lambda$ and in time $\Delta t$ resolution and the number of stored signals n

$$\alpha^2(\Delta\lambda)^2\Delta tn = \Phi$$

where $\Phi$ is some function of the light source and recording

Card 1/2

Measurement of electron concentration... S/057/61/031/001/014/017
B104/B204

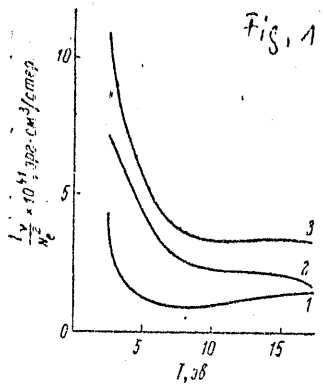
Legend to Table 1:
1) Discharge conditions;
$p_o$ - pressure in atm;
U - voltage in kv;
L - inductivity in microhenries;
2) Time of measurement in microseconds. 3) Electron concentration calculated from the intensity of the background. 4) Electron concentration calculated from the shift of the He II 4686-A-line.

| 1 Режим разряда | | | 2 | Концентрация электронов $N_e \cdot 10^{-16}$, $см^{-3}$ | |
|---|---|---|---|---|---|
| $p_o$, ат. | U, кв. | L, мкгн | t, мксек. | по интенсивности фона 3 | по сдвигу линии He II 4686 Å 4 |
| 15 | 9 | 0.18 | 0.1 | 10 | 2.9 |
| | | | 0.2 | 5.7 | 1.7 |
| | | | 0.3 | 4.1 | — |
| 15 | 9 | 0.5 | 0.2 | 4.7 | 2.5 |
| | | | 0.3 | 3.4 | — |
| 15 | 9 | 1.0 | 0.2 | 4.3 | 1.2 |
| | | | 0.3 | 3.2 | — |
| 4 | 2 | 0.18 | 0.1 | 2.9 | 0.7 |
| | | | 0.2 | 1.6 | — |
| | | | 0.3 | 1.2 | — |

Card 6/6

20669
S/057/61/031/001/014/017
B104/B204

Fig. 1




Legend to Fig. 1:
Temperature dependence of the intensity of the continuous spectrum of the plasma. Curve 1: emission of impurities; curve 2: emission of helium; curve 3: total emission of plasma.

of temperature in the plasma channel by means of the equation of state for the plasma and the known hydrodynamic relation $p \approx \rho_0 v^2$, where $\rho_0$ is the initial density of the gas, gave 5.2 and 18 ev, for the two above-mentioned electron concentrations. In accordance with the hydrodynamic theory of the development of a spark channel, the electron concentration may be described by $N_e \sim (\rho_0 U/L)^{2/3}/T$ (8). From this relation it may be seen that, in discharges occurring in gases heavier than helium, the plasma has a greater density. The gas composition was analyzed by O. P. Bochkova of LGU (Leningrad State University), who is thanked by the author. Moreover, he thanks V. I. Isayenko for photographic work, A. I. Sadykov for taking part in measurements, and M. P. Vanyukov for valuable advice and help. There are 5 figures, 1 table, and 15 references: 8 Soviet-bloc and 2 non-Soviet-bloc.

SUBMITTED: May 5, 1960

caloulated results shown in Fig. 1, the intensity of the continuous spectrum only slightly depends on temperature at $T > 5$-6 ev, and therefore an exact knowledge of the plasma temperature is not necessary for determining the electron concentration of a plasma whose temperature is within the range of 5-20 ev. As shown by experimental results, the radiation intensity of the discharge plasma only slightly depends on the wavelength. When calculating electron concentration, it was assumed that the temperature in the discharge channel was 5 ev. The electron concentration may then be calculated from the relation

$$N_e = 1.3 \cdot 10^{20} \sqrt{I_\gamma} \text{ cm}^{-3} \quad (7).$$

Results are given in Table 1, which shows that between the concentrations determined from the continuous background and those calculated according to the broadening of the He II 4686 A line there exists an exceedingly great difference. One of the causes for this is, according to the author's opinion, the fact that the theory of line broadening and shifting is not applicable to dense plasma. This is not changed, by considering the fact that the plasma is not perfect. A possible cause for this great deviation is the uneven electron distribution in the discharge channel. Calculation

discharge. The intensity which is generated by transition to levels with the quantum number n at $T > 6$ ev, where the helium is practically completely ionized, may be calculated from the expression $I_\nu = 2.77 \cdot 10^{-57} Z^4 N_e N_i T^{-3/2} n^{-3} \exp\{h(\nu_n - \nu)/T\}$ (3). With $T < 6$ ev, the helium is incompletely ionized. Here, intensity may be calculated from $I_\nu = 6.36 \cdot 10^{-47} Z_{eff}^2 N_e N_i T^{-1/2} \exp(\Delta E/T) \exp\{h(\nu_5 - \nu)/T\}$ (4). $\Delta E$ is the decrease of ionization energy caused by microfields in the plasma. In the experiments carried out by the author, the latter used two kinds of helium of different degrees of purity. The first kind was of 95% purity, the second of 99%. The emission of H could be neglected, while that of O, C, and N was taken into consideration by means of a formula by Kramers-Unsöld. For calculating the intensity of the continuous spectrum by means of the above formulas, the equilibrium ionization of the gas at a temperature of T=2.6 - 17 ev and at electron concentrations of $N_e = 2 \cdot 10^{18}$ cm$^{-3}$ and $2 \cdot 10^{19}$ cm$^{-3}$ was calculated. As may be seen from the

9.3150 (1049, 1140, 1532)
26.2311

S/057/61/031/001/014/017
B104/B204

AUTHOR: Mak, A. A.

TITLE: Measurement of electron concentration according to the intensity of the continuous spectrum of the plasma of a spark discharge

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 1, 1961, 94-99

TEXT: In the introduction, some methods for determining the concentration of charged particles in a plasma channel are discussed, and the results of several papers are presented. Next, the intensity of the continuous spectrum of a helium plasma is dealt with, and for the intensity of the bremsstrahlung of a plasma in the visible range of the spectrum at moderate temperatures, the expression

$$I_\nu = 6.36\cdot10^{-47} N_e T^{-1/2} \exp(-h\nu/T) \sum_i Z_i^2 N_i \qquad (2)$$ is given. $I_\nu$ is the energy radiated per $cm^3$ of plasma, $N_e$ and $N_i$ are the electron and ion concentrations, respectively; T is the temperature; and $Z_i$ is the ion

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20669

APPROVED FOR RELEASE: 06/23/11: CIA-RDP86-00513R001031400018-6

86034

The Maximum Brightness of a Spark Discharge Channel

S/020/60/135/003/013/039
B019/B077

surge increases. With the above-mentioned parameters of the current circuit opacity is easily obtained in heavy gases. The authors mention the relation between atomic weight and pressure of the gas which will produce a maximum brightness. The theoretical results agree very well with those found experimentally. There are 2 figures, 1 table, and 9 references: 6 Soviet, 1 German, and 1 US.

PRESENTED: May 25, 1960, by A. A. Lebedev, Academician

SUBMITTED: May 20, 1960

Card 2/2

86034

S/020/60/135/003/013/039
B019/B077

26.2313

AUTHORS: Vanyukov, M. P., Mak, A. A., and Sadykova, A. I.

TITLE: The Maximum Brightness of a Spark Discharge Channel

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 135, No. 3, pp. 557-559

TEXT: The authors investigated the maximum brightness of a spark discharge channel in argon, nitrogen, air, and helium at extreme high current surges ($U/L \approx 10^{12}$ a/sec). The high-pressure chamber used for these tests was developed by V. R. Muratov. The light was obtained through a special window. The discharge circuit consisted of the following parameters: C = 0.1 - 1.0 microfarad, L = 4 - 8 henry, and U = 2 - 10 kv. The discharge gap was 1.5 mm. In the range from 4000 - 9000 A the continuous background was studied, also the lines He II with 4686 A, Ar II with 4348 A, N III with 4097 A, and N II with 5045 A. The results show that the maximum brightness depends on producing an opacity of the discharge channel. With an increasing current surge the opacity will first appear in the red part of the spectrum and shift over to the blue part as the

Card 1/2

69271
S/051/60/008/04/002/032
E201/E691

An Investigation of Spark Discharges in Helium

"statistical wings" emitted by ions. The electron concentrations, N, in the spark discharge channel were derived from the half-widths and shifts of the He I lines at 3889 and 5016 Å (Table 2) and were compared (Table 3) with the values obtained by Mak (Ref 8), who studied the contour of the spark line at 4686 Å. The various values of N agreed better with each other when corrections suggested by Vaynshteyn and Sobel'man (Refs 15) were taken into account. However, even when these corrections were included the values of N ($\sim 10^{-17} cm^{-3}$) differed by 200-300%. There are 5 figures, 3 tables and 15 references, 7 of which are Soviet, 3 English, 3 German, 1 Swedish and 1 translation.

SUBMITTED: July 24, 1959

Card 2/2

69271
S/051/60/008/04/002/032
E201/E691

9.3150

AUTHORS: Vanyukov, M.P., Mak, A.A. and Muratov, V.R.

TITLE: An Investigation of Spark Discharges in Helium

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 4, pp 439-445 (USSR)

ABSTRACT: The authors studied the time dependence of the arc and spark line contours emitted by a spark discharge in helium. The discharge was produced by 2.5-10 kV pulses from a 0.05 μF capacitor (the inductance, L, of the discharge circuit was 0.18 or 3.6 or 25 μH). The sparks passed through a discharge tube filled with helium of industrial purity at a pressure of 2.5-12 atm. Emission was recorded in the wavelength region 2500-5500 Å. A Geisler discharge tube was used to produce a calibration spectrum. It was found that in the initial stages of the discharges a strong continuous background was emitted, superimposed on which there were two intense spark (He II) lines at 4686 and 3203 Å (Figs 1 and 2). Arc lines of helium (He I at 3188, 3889, 4470, 4471 and 5016 Å, cf. Figs 3-5) appear later, about 0.3-0.5 μsec from the beginning of the discharge. Both the spark and the arc lines emitted by these discharges were strongly broadened and displaced due to the Stark effect. The asymmetry of the arc lines was due to their

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Temperature of a Spark Discharge Channel in Air

in nitrogen (43 000 °K) reported by Vanyukov and Mak (Ref 2). This is due to the cooling effect of oxygen whose ionization and dissociation energies are lower than those of nitrogen (cf. Ref 1). Acknowledgment is made to M.P. Vanyukov for his advice. There are 1 figure, 1 table and 5 Soviet references.
Note: this is a complete translation apart from the figure and the references.

SUBMITTED: July 25, 1959

Card 2/2

Temperature of a Spark Discharge Channel in Air

| U/l (A/sec) | T ($^{o}$K) |
|---|---|
| $7.5 \times 10^{11}$ | $3.1 \times 10^{4}$ |
| $9 \times 10^{11}$ | $3.3 \times 10^{4}$ . |

At $U/l = 9 \times 10^{11}$ A/sec the spectral density of the background brightness showed that the discharge channel behaves as a black body in the visible region and this temperature is $T = 33\,000\ ^{o}K$. The temperatures given in the above table are means of several measurements of the maximum temperature. The scatter of the temperature lies within the limits of the experimental error of $\sim$ 30-35%. The results obtained show that the channel temperature is practically independent of the rate of current rise. This is confirmed by the recent results of Sukhodrev and Mandel'shtam on variations of the temperature of electrode vapours in a spark discharge (Ref 5). Temperature of an air spark ($\sim 30\,000\ ^{o}K$) are lower than those of a spark

Temperature of a Spark Discharge Channel in Air

photoelectric apparatus whose maximum time resolution was $5 \times 10^{-8}$ sec (Ref 3). At higher rates of current rise the temperature was deduced from the spectral density of the spark channel brightness at a wavelength representing the centre of gravity of the NII line at 5001 Å. The absorptive power of the channel at this wavelength was assumed to be equal to 1 at current-rise rates $U/L \geq 10^{11}$ A/sec, since it was found that the peak of this line was flattened out in the initial stages of the discharge, even when $U/L = 10^{11}$ A/sec (cf. figure on p 278). The following results were obtained:

| U/L (A/sec) | T (°K) |
|---|---|
| $1.3 \times 10^{8}$ | $2.9 \times 10^{4}$ |
| $3.2 \times 10^{8}$ | $2.9 \times 10^{4}$ |
| $6.8 \times 10^{8}$ | $3.0 \times 10^{4}$ |
| $2 \times 10^{9}$ | $2.6 \times 10^{4}$ |

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24.3400
9.3150

S/051/60/008/02/033/036
E201/E391

AUTHOR: Mak, A.A.

TITLE: Temperature of a Spark Discharge Channel in Air

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 2, pp 278 - 279 (USSR)

ABSTRACT: The author and Vanyukov (Refs 1, 2) examined the published data and suggested that the temperature of a spark discharge channel depends weakly on the rate of supply of energy into the spark gap. The present paper reports studies of dependence of the spark-channel temperature in air on the rate of rise of the current. The discharge had the following parameters: $C = 0.05$ μF; $U = 3$-$8$ kV; $L = 4 \times 10^{-9} - 5.4 \times 10^{-5}$ H; discharge gap length was 5 mm at $L > 4 \times 10^{-9}$ H and 1.5 mm at $L = 4 \times 10^{-9}$ H. At low rates of current rise ($U/L \leq 2 \times 10^{9}$ A/sec) the spark-channel temperature was determined by measuring the ratio of the intensities of the N II lines at 5535, 5495 and 5045 Å. These intensities were measured with

Card1/4

MAK, A. A. Cand Phys-Math Sci — (diss) "Investigation of the emission of an intensive spark discharge," Leningrad, 1960, 10 pp, 150 cop. (Leningrad State U im Zhdanov) (KL, 44-60, 128)

Mak, A.A. VANYUKOV, M. P.

Investigation of Spark Discharge Channel Brightness in Various Cases.

report submitted for: The 5th International High Speed Photography Congress, Washington, D. C. 16-22 Oct., 1960.

figure 2. It may be seen from the results that the temperature within the channel is constant in a considerable wide range of energy source and that the limits of this method of work may be determined. The absence of a temperature gradient within the spark channel, previously detected by P. G. [illegible] and S. L. Mandel'shtam (Ref 5), is mentioned in the further discussion of the results. There are 2 figures and 6 Soviet references.

24 (7), 24 (8)

AUTHORS: Vanyukov, M. P., Mak, A. A. SOV/48-23-8-6/21

TITLE: Maintenance of High Temperatures by Means of a Spark Discharge

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 8, pp 962 - 964 (USSR)

ABSTRACT: In connection with the development of light sources of high brightness, it is of great interest to find out how a maximum temperature within the spark channel may be maintained, and to obtain a picture of the temperature distribution in the mentioned channel. In the present paper the results of an investigation of the temperature within the spark channel, obtained by measuring the spectral intensity of the brightness, are described. The methods of measurements were previously described in another paper by the authors (Ref 1). The investigated lines of argon, xenon, and nitrogen are given. The dependence of the maximum spectral intensity of argon on the inductivity of the discharge circuit for 8 different wave lengths is given in the diagram of figure 1 and similar diagrams for the other gases investigated were elaborated (Ref 2). From these data the temperature was computed by means of Planck's formula and the results are summarized in the diagram of

Card 1/2

VANYUKOV, M.P.; YERMAKOV, B.A.; MAK, A.A.; MURATOV, V.R.

Record of the time variations of spectral line contours in the emission from a spark discharge. Vest.LGU 14 no.16:25-32 '59. (MIRA 12:10)

(Spectrum analysis)

VANYUKOV, M.P.; DOBRETSOV, A.F.; ISAYENKO, V.I.; MAK, A.A.

Powerful pulse light source. Usp.nauch.fot. 6:53-57 '59.
(MIRA 13:6)

(Electric discharge lighting)
(Photography, Flashlight)

VANYUKOV, M.P.; MAK, A.A.

Brightness of some pulse light sources. Usp.nauch.fot. 6:31-34 '59.
(MIRA 13:6)

(Electric discharge lighting)

Time Spectra of Emission by Spark Discharges in Inert Gases

of the continuous background differs greatly from that expected of a black body and was found to be only slightly dependent on the wavelength. This effect may be due to non-uniformity of the temperature distribution in various parts of the discharge channel and possibly also due to differences in the absorption coefficient of the discharge plasma in various spectral regions. There are 9 figures and 3 Soviet references.

SUBMITTED: March 4, 1958

Card 3/3

at various times t, counted from the beginning of the discharge. The first record was always obtained (with the exception of curve 1 in Fig 8) at the moment of the maximum intensity of emission. The results of measurements are given in Figs 1-9 in the form of two or three energy spectra obtained at various times. The results for argon are given in Figs 1 and 2, for krypton - in Figs 3-5, and for xenon - in Figs 6-9. The results of these figures show that increase of inductance in the discharge circuit reduces the intensity of continuous radiation and consequently the line emission becomes clearer. It was found that in the process of a spark discharge a continuous spectrum and lines of doubly ionized atoms appear first. Later the intensity of the doubly ionized lines decreases and instead the lines due to singly ionized atoms appear in the spectrum. The latter lines decay more slowly than the continuous background. The spectral distribution

.OV/51-6-1-3/30

AUTHORS: Vanyukov, M.P., Mak, A.A., and Muratov, V.K.

TITLE: Time Spectra of Emission by Spark Discharges in Inert Gases (Vremennyye spektry izlucheniya iskrovogo razryada v inertnykh gazakh)

PERIODICAL: Optika i Spektroskopiya, 1959, Vol 6, Nr 1, pp 17-23 (USSR)

ABSTRACT: The present paper describes time spectra of the intensity of emission by spherical pulse-discharge lamps filled with argon, xenon and krypton at 3.5 atm. The author studied the emission in the 2500-5500 Å region obtainable using various combinations of capacitance and inductance in the discharging circuit. The time spectra were obtained with photoelectric apparatus, whose resolving power was about $5 \times 10^{-8}$ sec, developed earlier and described in Ref 2. An Ebert--Fastī monochromator, with a mirror objective of 320 mm diameter and a diffraction grating with 600 lines/mm, was used. The relative spectral sensitivity of the apparatus was measured using a standard incandescent lamp (Ref 3). The absolute (energy) scale for the intensity of emission was obtained at 4140 Å by using an incandescent lamp whose spectral energy density was known for that wavelength. The spectral slit-widths used were from 2 to 20 Å. The instantaneous values of the emission intensity of pulse-discharge lamps were measured

Card 1/3

Time Spectra of the Radiation of Spark Discharges in Inert Gases

double-ionised gas atoms. If the storage condenser is decreased, the line in the vicinity of $\lambda = 3\,000$ Å is intensified. The lines of the double-ionised atoms appear during the initial stage of the discharge and are rapidly attenuated with time; the single-ionised atoms appear somewhat later and their attenuation is slower. There are 3 Soviet references.

SUBMITTED: March 5, 1959

Card 2/2

SOV/109-4-8-10/35

AUTHORS: Vanyukov, M.P., Mak, A.A. and Muratov, V.R.

TITLE: Time Spectra of the Radiation of Spark Discharges in Inert Gases

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 8, pp 1284 - 1285 (USSR)

ABSTRACT: Some data relating to the time spectra of the light pulses in the spectrum bandwidth, ranging from 2 500 - 12 000 Å, were recorded by means of the equipment devised by the authors (Ref 1). A detailed description of the equipment was given in Ref 2. The time resolution of the device was $5 \times 10^{-8}$ sec. The spark discharges investigated were produced between spherical electrodes in tubes filled with argon, krypton or xenon; the pressure of the gas was 3.5 atm. and the inter-electrode distance was 10 mm. The voltages applied to the tube were from 5 - 12 kV, the storage capacitance was 0.01 to 0.05 μF and the circuit inductance was 0.1 to 12 μH. It was found that the radiation of the discharge consists of a continuous background and a number of broadened lines, many of which can be identified with the lines of single- and

Card1/2

24(2)/20 SOV/109-4-8-22/35

AUTHORS: Granovskiy, V.L., Luk'yanov, S.Yu., Spivak, G.V. and Sirotenko, I.G.

TITLE: Report on the Second All-Union Conference on Gas Electronics

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 8, pp 1339 - 1358 (USSR)

ABSTRACT: The conference was organised by the Ac.Sc.USSR, the Ministry of Higher Education and Moscow State University.
T.B. Fogel'son - "Methods of Reducing the Energy Lost in the Formation of a Breakdown".
L.I. Pivovar and V.I. Gordiyenko - "Microdischarges and pre-breakdown Currents Between Metal Electrodes in High Vacuum".
V.A. Simonov and G.P. Katukov - "Investigation of the Processes of Initiation and Development of a High-voltage Discharge in Vacuum".
E.N. Reykhrudel and G.V. Smirnitskaya - "The Characteristics of Ignition in High-vacuum in Magnetic Fields".
V.V. Tarasov et al. dealt with the transfer of the electrode material during the pre-breakdown stage in vacuum.
N.B. Rozanov et al. - "The Motion of Micro-particles of Substances During Electric Breakdown in Vacuum".
The third section dealt with the problems of electric sparks, corona and their practical applications. It was presided over by I.S. Stekol'nikov. The following papers were read:
V.I. Lavitov et al. - "Probe Investigation of the a.c. Corona Fields".
G.N. Aleksandrov - "Elementary Processes in the Ionisation Zone of Corona-type Conductors at Atmospheric Pressures".
V.A. Burmakin - "Appearance of a Corona Discharge in Hydrogen and Nitrogen"
P.N. Chistyakov et al. - "Some Properties of the Corona Discharge in Hydrogen in Coaxial, Cylindrical System".
A.S. Sobolava and B.N. Klyarfel'd - "Appearance of Discharge Phenomena Between a Point and a Plane at Gas Pressures of $10^{-3}$ - 1.0 mm Hg".
Ya.Yu. Reyt et al. - "Methods of Unipolar Ionisation of Air By Means of Aero-ionisers (see p 1335 of the journal).
M.P. Vanyukov et al. - "Time Spectra of the Radiation of a Spark Discharge in Inert Gases" (see p 1283 of the journal).
M.P. Vanyukov and A.A. Mak - "Production of High Temperatures by Means of Spark Discharges".
V.A. Peretyagin - "Influence of the Magnetic Field of the Electric Discharge on the Dividing Surface of Two Media".
I.S. Stekol'nikov - "New Data From the Study of Long Sparks".
M.I. Syrkayev - "Properties of the Breakdown of Compressed Air in a Comparatively Uniform Field in the Presence of Localised Non-uniformities".
A.A. Vorob'yev et al. - "Pulse and Oscillographic Techniques for the Measurement of the Discharge Lags in Dielectrics" (see p 1257 of the journal).
A paper by B.N. Zolotykh dealt with the problem of the basic theory of the electric erosion (see p 1330 of the journal).
The fourth section was presided over by S.Yu. Luk'yanov and was concerned with the non-stationary and low-frequency discharges. The following papers were read:
I.G. Nakrashevich and A.A. Labud - "The Nature of the Current Interruption During the Electric Explosion of a Metal Wire".
V.A. Simonov - "Propagation of Plasma From Local Pulse Sources".
G.G. Timofeyev et al. - "Observation of an Electro-dynamically Compressed Arc By Means of an Electron-optical Converter".
M.S. Ioffe and Ye.Ye. Yushmanov - "Investigation of the Radial Electric Field in an Ion Magnetron".
V.A. Belyayev and M.K. Romanovskiy - "Experiments with an Electron Model of a System with Magnetic Samples".
A.M. Andrianov et al. "Distribution of Magnetic and Electric Fields in Powerful Pulse Discharges".
G.N. Harding (England) - "Spectroscopic Determination of the Plasma Temperature in the "Zeta" Equipment" (see p 1326 of the journal).
The paper by Harding aroused a lot of interest and Academician L.A. Artsimovich [illegible] of the opinion that the electrons [illegible] the "Zeta" should be of the same [illegible] as to Harding, the elect[illegible] of order than that

Card 7/15

MAK, A.A.

05449
SOV/120-59-3-20/48

Use of Storage in Recording Flash Spectra Photoelectrically

stage, together with the gates and stores. Fig 4 shows the contour of the 2605 A line of Xe III at $2 \cdot 10^{-9}$ sec after the start of a discharge from 0.05 μF capacitor charged to 12 kV; the integrating time is 10 sec, with a repetition frequency of 15 c/s. The time resolution is $5 \times 10^{-8}$ sec; the wavelength resolution is 1.5 A. There are 4 figures and 8 references, 5 of which are Soviet and 3 western.

ASSOCIATION: Gosudarstvennyy opticheskiy institut (State Optical Institute)

SUBMITTED: March, 24, 1958

Card 2/2

05449
SOV/120-59-3-20/46

AUTHORS: Yermakov, B. A., and Mak, A. A.

TITLE: Use of Storage in Recording Flash Spectra Photoelectrically (Primeneniye metoda nakopleniya pri fotoelektricheskoy registratsii vremennykh spektrov svetovykh vspyshek)

PERIODICAL: Pribory i tekhnika eksperimenta, 1959, Nr 3, pp 94-97 (USSR)

ABSTRACT: The system is illustrated by Fig 1, in which 1 is the pulsed (repetitive) light source, 2 is the grating monochromator, 3 is the photomultiplier, 4 is the amplifier, 5 is the delay line (with a synchronizing pulse input), 6 is the gating-pulse generator, 7 and 7' are electronic gates, 8 and 8' are stores, 9 is the output stage, and 10 is a recorder. (The object of 7' and 8' is to improve the stability of the zero reading.) The second section deals with the errors of measurement and with the choice of scan rate. The third section describes the units briefly; amplifier 4 is a normal video-amplifier with a rise time of 0.05 μsec and with a gain of 100. The amplifier is linear up to 3 V output. The gating-pulse generator uses a thyratron to discharge a delay line. Fig. 3 shows the differential output

Card 1/2

Recording of the Variation With Time of the Contours of Spectral Lines in the Radiation of a Spark Discharge

SOV/54-59-3-5/21

It was found from the helium line II 4686 Å that it is $\sim 10^{18}$ cm$^{3}$. Also the arc discharge spectra of helium could be recorded. The observed asymmetry of the lines could be explained by the direction of the line shift. There are 7 figures and 7 references, 3 of which are Soviet.

SUBMITTED: April 14, 1959

Card 3/3

the pulse obtained at the outlet of the electron trigger is proportional to the value average with respect to time $\Delta t$ of the signal to be investigated for a given period of delay $t_3$. The pulses obtained are thus modulated according to the spectral radiation distribution of the pulse source for time $t_3$. These pulses arrive at a collecting scheme, subsequently at a direct-current amplifier, and finally at the selfrecording potentiometer. The three channels record in the time intervals 0.05 - 0.45 $\mu$sec, 0.4 - 20 $\mu$sec, and 0.5 - 50 $\mu$sec. For the determination of the best working conditions the time of adjustment of the collecting element was varied. By means of this device line contours and also the shift of the maxima toward 0.1 Å may be observed. The limit of the time resolving power with time is $5.10^{-8}$ sec. In the figures 2-7 the contours of the spectral lines of nitrogen and helium in spark discharge tubes are represented. Herefrom it may be seen that the lines widen mainly in the first stage of discharge (Fig 7) which indicates a Stark line widening. The maximum concentration of the charged particles is observed at the beginning of discharge.

SOV/54-59-3-5/21

24(7)

AUTHORS: Vanyukov, M. P., Yermakov, B. A., Mak, A. A., Muratov, V. R.

TITLE: Recording of the Variation With Time of the Contours of Spectral Lines in the Radiation of a Spark Discharge

PERIODICAL: Vestnik Leningradskogo universiteta. Seriya fiziki i khimii, 1959, Nr 3, pp 25-32 (USSR)

ABSTRACT: In the present paper a three-channel photoelectric apparatus for the recording of the variations with time pulses of the discharge spectra is developed for a wide intensity interval. The scheme of the apparatus is represented in figure 1. The spectral decomposition of the periodic discharges was made by means of a monochromator according to Eberth and Fast with a plane diffraction grating for interferences of first order. The grating was constructed by F. M. Gerasimov in the GOI Laboratory. During the recording the grating slowly rotated. It was connected with an electron selfrecording potentiometer of the type EPP-0.9 over a synchronous transmitter. The angular velocity of the grating could be adjusted gradually from 60 to 12, 2.5, 0.5, and 0.1 Å/min. The radio apparatus consisted of three uniform channels permitting a simultaneous recording of the spectrum at three different instants, i.e. the amplitude of

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On the Temperature of the Channel of a Spark Discharge SOV/20-123-6-18/50

saturation value. The continuous and the discrete radiation of the discharge in nitrogen (p = 2 atm) was investigated in the spectral region 4000-6000 Å. Under these conditions, brightness was saturated at wave lengths above 5500 Å for continuous irradiation and also for all the investigated lines ($\lambda$ 4097; 5001; and 5045 Å). According to Planck (Plank)'s formula for the irradiation of an absolutely black body, the authors calculated the temperatures which correspond to the spectral densities of the brightness for those wave lines of the discrete and of the continuous spectra for which a saturation of the brightness was observed. The straggling of the temperature values for various wave lengths is very small, especially for xenon and nitrogen. According to these results, the temperature of the channel of the spark discharge only to a small extent depends on the rate of entering of the energy into this channel. The distribution of the temperature over the cross section of the channel appears to be uniform. The authors thank V. R. Muratov who assisted in carrying out some of the measurements. There are 4 figures and 9 references, 8 of which are Soviet.

PRESENTED: July 7, 1958, by A. A. Lebedev, Academician

SUBMITTED: June 27, 1957

Card 2/2

24(3)

AUTHORS: Vanyukov, M. P., Mak, A. A.

SOV/20-123-6-19/50

TITLE: On the Temperature of the Channel of a Spark Discharge
(O temperature kanala iskrovogo razryada)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol 123, Nr 6, pp 1022-1024
(USSR)

ABSTRACT: This paper discusses the results obtained by measuring the temperature of the channel of spark discharges in argon, xenon and hydrogen by determining the spectral density of channel brightness for wave lengths which correspond to the center of gravity of the lines. These measurements are carried out for various rates of entering of the energy into the discharge-channel. Measuring methods were discussed in a previous paper. The measuring apparatus is discussed in short. The radiation was investigated in argon for the lines 4806; 4348, and 3538 Å, in xenon for 2900 and 2600 Å. The results of the measurements are shown by 2 figures. In the investigated interval of variation of contour inductivity, the discrete radiation (lines) of argon and xenon reached practically the extreme value. Continuous radiation, however, at $< 4000$ Å by far does not reach

Card 1/2

probably due to an increase of the specific heat of the gas and also to a great extent to the influence exercised by the capillary walls. Investigation of brightness distribution in the discharge channel showed the following: From the front surface onward, the brightness of the whole luminescent body is the same, but in the direction vertical to the discharge axis brightness decreases towards the edges of the luminescent body. This decrease becomes less with increasing wave length, which is probably connected with the increase of the absorption coefficient of radiation with increasing wave length. In the case of sufficiently high voltage, the introduction of an additional open spark gap need not exercise much influence on the brightness and the temperature of the discharge channel in the capillary. The author thanks M. P. Vanyukov for his constant interest he displayed in this work, for his valuable advice, as well as for discussing the results of measurements. There are 3 figures and 5 Soviet references.

High Temperature Surging Light Source

SOV/20-121-4-36/53

ness at first increases, attains a maximum value with a diameter of from 0.5 to 0.8 mm, after which it begins to decrease rapidly. Like in the case of an ordinary capillary discharge, a certain optimum cavity diameter thus exists, at which the brightness of the discharge channel attains its maximum value. A diagram shows the dependence of the momentary spectral density of discharge channel brightness on the wave length for the point of time 0.2 μsec after the beginning of the discharge. Brightness was measured vertical to the discharge axis. The brightness measured on the front surface of the channel agrees in the entire spectral range under investigation with that brightness which was measured vertical to the discharge axis. The absorption capacity of the plasma in the channel is equal to 1 in the case of the kinds of discharge investigated and in the case of the capillary dimensions chosen. The spectral distribution of the discharge channel radiation agrees well with that of a black body. A further diagram shows the dependence of the maximum discharge channel temperature upon the amount of the initial condenser voltage for the diameter 0.5 mm of the capillary. The rising of channel temperature slows down with increasing voltage. This is

Card 2/4

24(4)

AUTHOR: Mak, A. A.

TITLE: High Temperature Surging Light Source (Vysokotemperaturnyy impul'snyy istochnik sveta)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol 123, Nr 4, pp 631-633 (USSR)

ABSTRACT: The present paper describes the results obtained by investigating the optical characteristics of a spark discharge in a cavity bounded by a water wall. This cavity is produced by means of a turbine. The circuit diagram of the measuring apparatus is shown by a schematical drawing. The brightness of the discharge channel was determined photoelectrically. The resolving power with respect to time of the measuring apparatus amounted to $5 \cdot 10^{-8}$ sec. The duration of the light pulse in the case of the circuits used was from 0.5 to 0.7 μsec, the reproducibility of the amplitude and the duration of the pulse were satisfactory (scattering 20-30%). Investigation of the dependence of the discharge channel brightness on the diameter of the cavity showed the following: With a decrease of the cavity diameter from 1 to 0.4 mm bright-

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1/3

II. Spark discharges in capillaries (Refs 13, 19, 25, 59 etc.). Wiring scheme for parallel condensers, $C_i$ = 100 μF, $L_i$ = 1,5 μH. Investigation of the optical properties of the plasma in spark discharges (Refs 25, 29, 31, 32, 40, 50, 60, 61). Parameters are shown in table 2. Investigation of the connection between temperature and voltage (Fig 17, Ref 32); the influence exercised by the material of tube walls (Refs 52, 60, 62-64).
III. Sliding spark discharges (discharges between electrodes located on the surface of dielectrics). Duration of flashes: $10^{-6}$ - $10^{-7}$ sec (Refs 65-74, 13) "Defatron" ($10^{-6}$ sec, 200 J, 22 kV) wiring scheme for defatron spark discharge (Fig 16).
IV. Electric wire explosions (the wire material goes over into metal vapor in the manner of an explosion, high temperature plasma, $10^{-6}$ - $10^{-7}$ sec) (Refs 76, 77-87), determination of temperatures: references 28, 29 (20 000 - 30 000°K); photometrical investigations (Ref 31); reference 31: 7 - 15,000°K.
V. Shock waves, Propagation of shock waves: Zel'dovich, Rayzer (Ref 53), further, references 92 - 97, determination of the temperature of a wave front in inert gases etc.
VI. Possibilities of further increase of temperatures. Short survey. Theoretically, it could be possible to attain temperatures of the order of $10^{9}$°K (Ref 100). There are 20 figures.

and N - the number of particles per cm of the length of the discharge channel.

I. 3) The maximum degree of brightness attainable by means of spark discharges in gases. Systematic investigations carried out by Vul'fson, Libin, Chernaya (Ref 46), investigations of the saturation effect (Refs 22, 23); photoelectric methods; investigation of the spectral intensity dependence on time in the individual parts of the discharge channel (Figs 8, 9), in dependence on L (Fig 10) (Refs 22, 47); investigation of the intensity of spark discharges in air (Ref 48), in noble gases, nitrogen, oxygen, and helium (Ref 26), etc. Table 1 shows a collection of values for the temperature and brightness of various gases arranged according to authors and references.

I. 4) Physical processes limiting the brightness of spark discharges (Refs 4, 15, 22, 23, 26), Zel'dovich (Refs 51, 52), Rayzer (Ref 52); dependence of the absorption coefficient of radiation on T, formula by Kramers; (Refs 23, 26; Fig 14): dependence of the spectral density of brightness on λ. Dolgov, Mandel'shtam (Ref 55) investigated the density distribution in gas in a spark discharge.

(Fig 2, Ref 12); pulse tube with ceramic condensers (Fig 3) as constructed by Vanyukov, Dobretsov, Isayenko, Mak - 28 kV, 0.022 μF, 0.06 μH, to 4 kW; coaxial condenser according to Fisher (Ref 15), high-voltage toroid condenser (Ref 16); discharge circuit for large pulses and small L - investigated by Komel'kov and Aretov (Ref 20), construction of 40 different condensers ~134 μF, operating voltage 50 kV and L = 0.025 μH; maximum current in the circuit $2.1.10^6$ A.

I.2) Methods of measuring brightness and temperatures (Refs 15, 22 - 27). Measurement of temperature in spark discharges (Refs 25, 28); photographic method (Refs 24, 27); photoelectric method (Refs 4, 11, 15, 22, 23, 26, 29, 30-32); photochronograph (Fig 6); photoelectric device for the measurement of brightness developed by Vanyukov, Mak, Parazinskaya, (Ref 22, Fig 7). Furthermore, a number of theoretical investigations was discussed as e.g. the investigation of the distribution of atoms and ionization in the channel of a spark discharge (Refs 22, 23, 29, 31, 32); investigation of the spectral distribution of radiation (according to Planck's law); Komel'kov and Parfenov (Ref 44) calculated the plasma temperature in spark discharges according to the theory of the pinch effect (Ref 45): $2NkT = I^2$, where I denotes the discharge current

AUTHORS: Vanyukov, M. P., Mak, A. A. SOV/53-66-2-3/9

TITLE: Pulsed Light Sources of Great Brightness (Impul'snyye istochniki sveta vysokoy yarkosti)

PERIODICAL: Uspekhi fizicheskikh nauk, 1958, Vol 66, Nr 2, pp 301-32? (USSR)

ABSTRACT: The present paper is an abstract compiled from 100 Soviet and non-Soviet publications. It gives a concentrated survey of the present stage of spark-discharge devices, their characteristics, and their theories. Chapter I.: Spark discharges in gases. Emission of radiation caused by the slowing-down of electrons in the field of positive ions (free-free transition), by the recombination of electrons and ions (transition from a free to a bound state), and by transitions from bound to bound states - emission of considerably broadened lines.
I. 1) Methods of producing spark discharges of high intensity: Connection between $U_o$, C, L, $\omega$t, molecular weight of the gas, pressure; discussion of a pulse tube with condenser according to Frünge1 (Fryungel') (Ref 11, Fig 1), scheme of discharge circuit with condensers connected in parallel

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VANYUKOV, M.P.; MAK, A.A.

Temperature of a spark discharge channel. Dokl.AN SSSR 123 no.6:1022-1024 D '58. (MIRA 12:1)

1. Predstavleno akademikom A.A. Lebedevym.
(Electric discharges through gases)

Instantaneous Brightness of a Spark-Discharge Channel in a Capillary.

less than the corresponding brightness in the spherical lamp ($11 \times 10^6$ stilbs). This is due to the fact that the discharge-channel width in a 2.5 mm capillary is limited by that capillary at a comparatively late stage of the discharge. Figs.1 and 2 show that radiation from a capillary discharge differs considerably from black-body radiation (dashed curves), except at high energy densities in the discharge channel (Fig.1, curves 1 and 3). The results obtained are summarized in a table on p.92. There are 2 figures, 1 table and 5 references, of which 4 are Russian and 1 American.

Card 4/4

ASSOCIATION: State Institute of Optics imeni S. I. Vavilov. (Gos. opticheskiy institut im. S. I. Vavilova.)

SUBMITTED: March 18, 1957.

AVAILABLE: Library of Congress.

1. Capillaries-Spark discharge-Brightness
2. Capillaries-Spectral density

Instantaneous Brightness of a Spark-Discharge Channel in a Capillary.

energy of discharge through a capillary increases brightness. The highest brightness of $50 \times 10^6$ stilbs was obtained in a channel 0.4 mm wide, filled with air at atmospheric pressure, on discharging a 0.011 μF condenser charged to 29 kV. The brightness temperature for this case was 94 000°K. Increase of the inter-electrode distance from 10 to 20 mm does not appreciably change the spectral density of brightness. Fig.2 shows the results for xenon in a 2.5 mm capillary filled with xenon at 4 atm (curve 1) and for a spherical pulse-discharge lamp also filled with xenon (curve 2). The results of Fig.2 show that brightness

 in a capillary filled with xenon ($7 \times 10^6$ stilbs) is

Instantaneous Brightness of a Spark-Discharge Channel in a Capillary.

capillary. For the sake of comparison, measurements of brightness of the spark discharge were made also in an unbounded air gap. Fig.1 shows curves, for air, of the spectral density of brightness as function of the wavelength under various discharge conditions at the moment when the spectral density of brightness at 4494 Å reaches its maximum. At constant discharge energy narrowing of the discharge channel by the capillary produces an increase of the channel brightness, particularly in the short-wavelength part of the spectrum. Decrease of the capillary diameter cannot be carried on indefinitely since in very narrow capillaries brightness decreases (e.g. in 0.25 mm capillary brightness is less than in the 0.4 mm capillary). Increase of the

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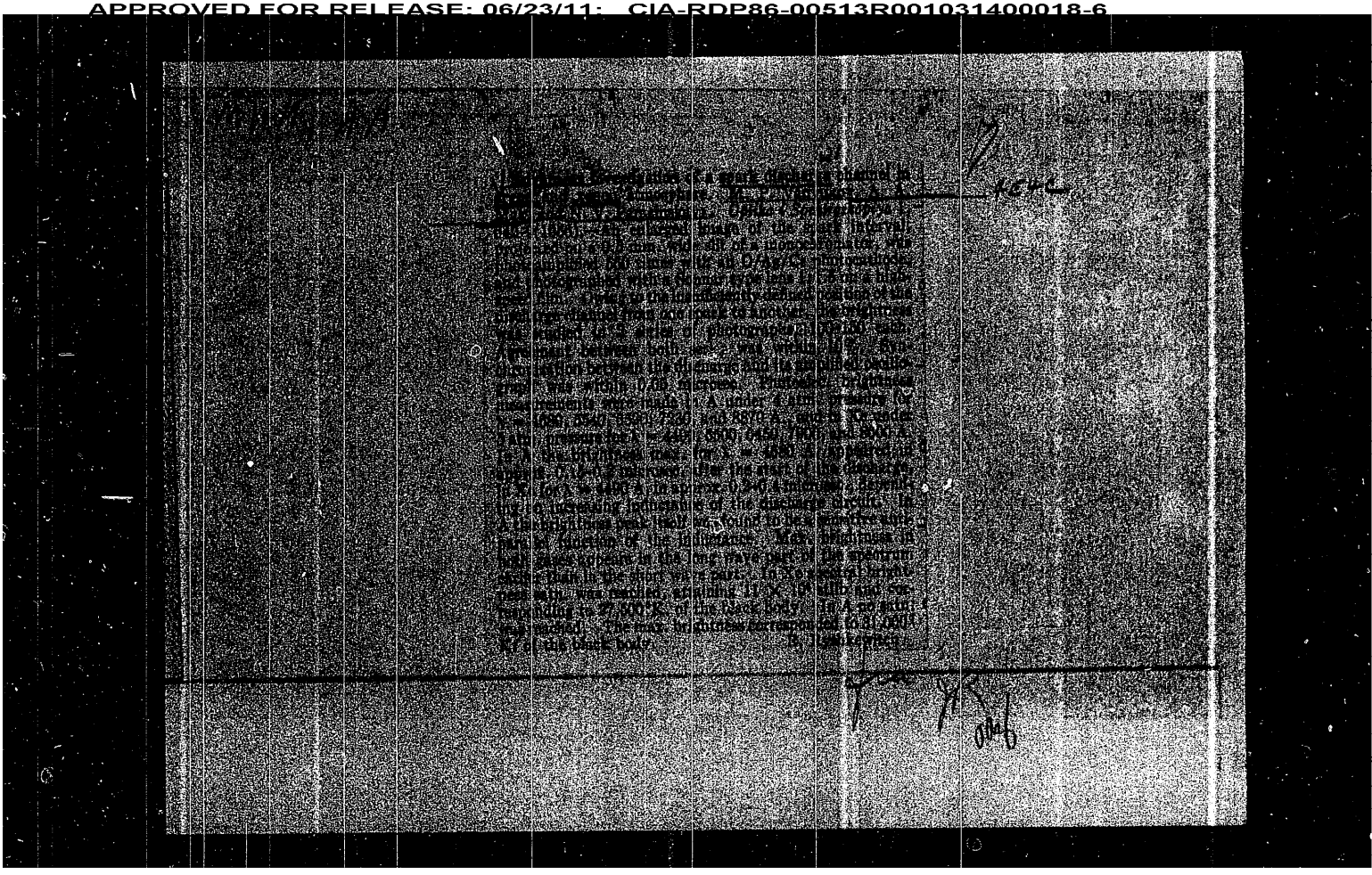
AUTHORS: Vanyukov, M. P., Mak, A. A. and Ures, M. Ya.

TITLE: Instantaneous Brightness of a Spark-Discharge Channel in a Capillary. (Mgnovennaya yarkost' kanala iskrovogo razryada v kapillyare.).

PERIODICAL: Optika i Spektroskopiya, 1958, Vol.IV, Nr.1, pp. 90-92. (USSR)

ABSTRACT: The paper reports results of measurements of the spectral density of brightness of a spark discharge channel in capillaries filled with air at atmospheric pressure, or with xenon at 4 atm. The technique of measurement and apparatus are described in Ref.2. Capillaries filled with air were glass tubes with internal diameter of 0.25, 0.4 and 1.35 mm and an inter-electrode distance of 10 mm. Capillaries filled with xenon were quartz tubes with an internal diameter of 2.5 mm. Brightness

Card 1/4 was measured in the direction at right-angles to the



MAJZON, L.

Stratigraphic range of planktonic foraminifera in Hungary.
Acta geol Hung 8 no.1/4:283-300 '64.

1. Hungarian Petroleum Trust, Budapest.

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Nomenclatural modification of Miksa Hantken's work entitled "The fauna of the Clavulina Szaboi strata." Foldt kozl 92 no.3:268-273 Jl-S '62.

1. "Foldtani Kozlony" szerkeszto bizottsagi tagja.

MAJZON, Laszlo, dr.ac.

In commemoration of Miksa Hantken. Foldt kozl 92 no.3:258-267 Jl-S '62.

1. "Foldtani Kozlony" szerkeszto bizottsagi tagja.